ATTRIBUTE ENERGY CONSUMPTION THROUGH POWER SENSING AND USER LOCALIZATIONS

BACKGROUND

[0001] Technical Field

[0002] This disclosure relates to power consumption, and more particularly to attributing power consumption to particular individuals.

[0003] Description of Related Art

[0004] Virtually everyone consumes energy for entertaining, working, transportation, communicating and for controlling the ambient temperature of locations in which people live and work. It is estimated that the United States consumes approximately one fourth of the world's energy. Despite this vast consumption, it is difficult, if not impossible, to attribute an amount of energy consumed to various individuals. This is especially true in workplace environments where large numbers of energy consuming devices are utilized by various workers. Some of these energy consuming devices might not be utilized by any of the workers, but such non-usage is also very difficult to ascertain.

SUMMARY

[0005] An approach is provided for attributing energy usage to individual occupants in an area, such as a building or office space. The approach receives current locations of occupants from sensors deployed in the area being monitored. Identifiers corresponding to various occupants are determined, such as by tracking the occupants' mobile telephone location, biometrics such as facial recognition, or other device-enabled means of identifying people. Energy consumption values corresponding to energy consuming devices are received and device locations are identified. The approach further attributes the amount of energy consumed by each of the occupants, with the energy attribution being based on the occupants' current locations and the device locations.

[0006] The foregoing is a summary and thus contains, by necessity, simplifications, generalizations, and omissions of detail; consequently, those skilled in the art will appreciate that the summary is illustrative only and is not intended to be in any way limiting. Other aspects, features, and advantages of the present disclosure will be apparent in the non-limiting detailed description set forth below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Embodiments of the present invention may be better understood, and its numerous objects, features, and advantages made apparent to those skilled in the art by referencing the accompanying drawings, wherein:

[0008] FIG. **1** depicts a block diagram of a processor and components of an information handling system;

[0009] FIG. **2** is a network environment that includes various types of information handling systems interconnected via a computer network;

[0010] FIG. **3** is a component diagram depicting interaction between the components that attribute energy consumption through power sensing and user localizations;

[0011] FIG. **4** is a layer diagram depicting the various layers and functions to provide occupant-based energy management;

[0012] FIG. **5** is a flowchart showing steps that perform individual occupant-level energy management;

[0013] FIG. **6** is a flowchart showing steps that generate an occupants map of an area;

[0014] FIG. **7** is a flowchart showing steps that generate a device-occupant attribution graph;

[0015] FIG. **8** is a flowchart showing steps that compute occupant-based energy usage and waste; and

[0016] FIG. **9** is a flowchart showing steps that report occupant-based energy consumption.

DETAILED DESCRIPTION

[0017] FIGS. **1-9** show an approach for attributing energy consumption through power sensing and user localizations. The approach constructs a temporal occupancy heat map over time. Essentially, the occupancy heat map uses indoor localization technology to track the locations of occupants and power consuming devices over time. The energy heat map uses power sensing/monitoring devices to track the real-time energy consumption of power consuming devices. Correlating the location and energy consumption heat map with graph matching and graph analysis, such that the energy consumption of devices can be systematically attributed to individual users, and sources of energy wasted can be identified.

[0018] A device location map is constructed to have a basic map of devices in the area being monitored. The approach retrieves the locations of conference rooms (including projector, etc), microwaves, elevators, printers, desktops, servers, and the like. The energy consumption data is collected for devices and power sensing/monitoring devices are used to track the real-time energy consumption of power consuming devices. A people occupancy map is constructed. Indoor localization technology is used to track the locations of occupants. This technology includes people's mobile phones, smart watches, other smart devices, etc.

[0019] The device-people attribution graph is then built. If a device is being utilized by an occupant, either proactively or passively, then there is a connection between the device node and the occupant node on the graph. In one embodiment, an occupant is deemed to be utilizing devices if the occupant is within the service range of the device (via positioning technology) or directly using the device, such as a computer system. The approach compares the people occupancy map with the device location map. A graph matching technique can be used. By determining that an energy consuming device is at a location at a time point and particular occupants were at the same location, then the occupant nodes can be connected to the device nodes.

[0020] The energy used by each occupant is then computed. For each occupant node, the amortized energy from each device is calculated based on the number of occupants using the device. The total energy consumed by the device d will be averaged among the users using it. In this manner, the total energy used by any occupant is calculated as the sum of all energy consumed by the devices pointing to the occupant node.

[0021] The approach also Identifies the devices that are not being used by any occupants and thus the energy wasted amount is computed. If there are devices nodes in the graph that do not have connections to occupant nodes, it signifies that such devices are not being used and the energy consumed by such device is being wasted.